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# SADRŽAJ / CONTENTS

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# MANIFESTATION, ASSESSMENT AND EVALUATION OF EXPLOSIVE STRENGTH AT 7 YEARS OLD CHILDREN

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## INTRODUCTION

Motor abilities as a fundamental determinant of human motor space represent the essence of human motor movements and are in relation of development of human individual potentials (Jovanovski, 2013). Development, following and evaluation of motor abilities is one of the main assignments of physical education and sports training, as well as one of the main criteria for sports selection in certain sport disciplines. Development of motor abilities is also one of the main goals of physical education (PE), defined in national curriculum for nine – years compulsory education in Republic of Macedonia (Bureau for the development of education, 2007), while in PE teaching process is defined as one of the concrete goals in the segment named as "movement" (Klincarov, 2007), goals that are equivalent on educational assignments. Motor abilities are also highly related with the acquisition of different motor skills and habits (Matič, 1978). Therefore, changes in motor abilities are one of the criteria for creation of final grade from the subject physical and health education, criteria for following and evaluation of individual development and improvement of every child and also a manner for determination of efficiency of applied PE curriculum.

As a part of the abilities that defines human motor space, strength abilities are highly related with other motor abilities, and have a significant role in successful performance in many movements. Strength is defined as a human`s qualitative characteristic manifested in certain movement, respectively ability of the muscles to affect on relatively large force with small externnal resistance, but with high speed of contraction of the muscules (Kukolj, 2006). Using the type of muscule work as a criteria for classification of strength, explosive, repetative asnd static strength are classified in the groupe of action types of strength. Explosive strength is frequntly defined as a human ability for short – term maximal mobilisation of muscule forces for acceleration of the movement of the body that moves in space or it used to influence on the object (Kureli et al, 1975), respectively an ability to activate maximal number of motor units for shorter time. Explosive strength, esspecialy in the early school period is related with successful performance of many movements and is closely related with other motor abilities, esspecialy with coordination and speed. The mutualy replanish and in certain sense „help one another "in the realization of the movements.

Motor abilities in children are manifested and developed differently compared with adults. These is result of uncompleted development, uncompleted regulations of CNS, ongoing functional development, individual tempo of development, concerning different "biological time" on every individual and other characteristics specific for children age period. Therefore, beside regular demands for standardization and good metric characteristics, motor tasks used in tests for estimation of children's` motor abilities, should be conducted as a content of education curricula for certain age, or should be specially designed or modified for certain age group. According the authors Ikeda &

Aoyagi (2007) is especially hard to select a motor tests for children that will be enough reliable, valid and practical because little children still have not developed sense for time and rivalry (Matsuda, 1961). Difficulties in realization of measurements of children motor abilities are noted in researches of Bala, 1999; 2007; Rajtamer, 1997; Popeska, 2009, 2011.

In different age periods, strength is manifested at different manners. At 6 and 7 years old children strength has a significant changes compared with periods before. Performance of the movement is intensively improved. Because of this improvement, as well as because of functional changes in the muscle system because of development processes, there is a significant enlargement of muscle tissue and muscle mass, which results with improvement of manifestation of the strength (Gallahue, 1987; Malina & Bouchard, 1991). Strength improves gradually with children's growth and development. At smaller age, there is no significant differences in strength between boys and girls, while at the age of 7, occurs a process of differentiation of the strength, manifested as a better muscular shapes in boys compared with girls (Findak, 1995, Pišot&Planinšec, 2005). The strength and muscle endurance continuous to improve linearly with children`s age until the age of 13 – 14 years old (Malina & Bouchard, 1991). Ligament tendon and muscles becomes stronger, but are not yet prepared to endure huge external strain (Hughston, 1986; Portmann, 1993). Possibilities for improvement of explosive strength are limited because of its high percent of heredity h = 0.80 which is related with motor efficiency as an individual characteristic of the person (Jovanovski, 1998).

All previously explained notes, emphasize that motor abilities, including the explosive strength are conditioned by children's` age and are manifested and developed differently in every certain age period. Therefore, findings about children motor abilities in every age period, specific manners of their manifestation and development as well as possibilities for their following and estimation are key issues for the PE teaching process. All these issues were foundation for this paper, which aim is to determine metric characteristics of motor tests used for estimation of explosive strength at 7 years old children and normative for evaluation of children's achievements as an objective for determination of children's achievements and following of their individual improvement.

## METHOD

The research was conducted as a part of larger study (Popeska, 2011) realized on a sample of 123 examiners, 7 years old male children, pupils in second grade in five primary schools in Skopje, Republic of Macedonia. The examiners were tested in four motor tests hypothetically used for estimation of explosive strength. Following tests were used: Standing broad jump (ESSDM), Throwing medicine ball 1 kg from standing position (ESFMST), Throwing medicine ball 1 kg from sitting position (ESFMG) and 20m dash running (ES20VS)[1)]. The applied tests were previously used in different researches with children in pre - school and early school period, notes, and recommendations from the authors are implemented in the measuring procedure. The tests: Throwing medicine ball 1 kg from standing position (ESFMST) and Throwing medicine ball 1 kg from sitting position (ESFMG) were previously used and recommended by Perić (1991), the test Standing broad jump (ESSDM) is measured by the recommendation of Dukovski (1984), while the test 20m dash running (ES20VS) is previously used and recommended by Bala (1981). All used tests were applied as two – item tests, realized with two repetitions. Aldo two repetitions is a small number considering the main goal – determination of metric characteristic, considering the age and possibilities of examiners this number is accepted and needed. This is also noted and recommended by other authors that realized researches with same age groups (Bala 1981, Pisot & Planinsec,2005).

Tests characteristics: discriminativity (sensitivity), asymmetric, homogeneity, reliability, validity and representatively are fortified for all four used tests. Discriminativity, asymmetric and homogeneity were determined using measures for tendency and dispersion, while reliability, validity and representativity were estimated based of Crombah α and Spearman – Brown`s (SB) coefficients of

[1)] Detailed description of the performance of used tests and there measurements are available at the authors.

reliability[2)], the value of significant root, the projections of isolated factor and communalities obtained using Hotelling procedure for determination of validity[3)] and Kaiser-Meyer-Olkin`s measure[4)] for reliability and representativity.

Normative for children's achievements in motor tests are defined using percentile classes and percentile values for 1, 3, 5, 10, 20, 25,30, 40, 50, 60, 70, 75, 80, 90, 95, 97 and 99 percentile. The results in final table for estimation of children`s motor achievements are obtained with reduction of percentile distribution in 5 percentile classes defined as: above 95 percentile –excellent achievement; from 75 to 95 percentile – achievement above average; from 26 to 75 percentile – average achievement; from 5 to 25 percentile – below average achievement and under 5 percentile – very bad achievement.

## RESULTS AND DISCUSSION

Basic descriptive statistics parameters for all four applied tests for estimation of explosive strength at 7 years old are presented in Table 1. Obtained results for reliability, validity and representativity for every certain test are presented in Tables 2,3,4 and 5.

**Table 1.** Basic measures of central tendency, dispersion and normality of distribution of motor tests used for estimation of speed at 7 years old children (second grade)

| | Mean | SD | Sx | KV | MIN | MAX | Range | skew | Kurt | KS | P |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **ESSDM1** | 109,28 | 19,69 | 1,78 | 18,02 | 63 | 150 | 87 | -0,09 | -0,75 | 0,11 | p < ,10 |
| **ESSDM2** | 110,94 | 19,77 | 1,78 | 17,82 | 60 | 150 | 90 | -0,20 | -0,74 | 0,12 | p < ,05 |
| **ESFMST1** | 3,37 | 0,93 | 0,08 | 27,63 | 1,5 | 6,5 | 5 | 0,64 | 0,85 | 0,11 | p < ,15 |
| **ESFMST2** | 3,42 | 1,01 | 0,09 | 29,63 | 1,7 | 6,5 | 4,8 | 0,84 | 0,54 | 0,11 | p < ,10 |
| **ESFMG1** | 1,67 | 0,52 | 0,05 | 31,45 | 1 | 4 | 3 | 1,47 | 3,25 | 0,17 | p < ,01* |
| **ESFMG2** | 1,72 | 0,57 | 0,05 | 32,93 | 1 | 4 | 3 | 1,16 | 1,66 | 0,14 | p < ,05 |
| **ES20VS1** | 4,75 | 0,63 | 0,06 | 13,21 | 2,56 | 6,4 | 3,84 | -0,42 | 1,00 | 0,09 | p > ,20 |
| **ES20VS2** | 4,84 | 0,70 | 0,06 | 14,57 | 2,52 | 7,2 | 4,68 | 0,39 | 1,84 | 0,10 | p < ,20 |

**Table 2.** Standing broad jump (ESSDM): reliability, validity and representativity obtained at 7 years old children

| Ajtems | r and SMC | | H 1 | $h^2$ |
|---|---|---|---|---|
| **ESSDM 1** | (.82) | | .98 | .95 |
| **ESSDM 2** | .91 | (.82) | .98 | .95 |
| **Cranach's α** | .95 | | Lambda | 1,91 |
| **SB** | .95 | | % | 95,32 |
| **KMO** | .50 | | | |

[2)] Coefficients higher than 0.80 are considered significant

[3)] Internal validity, between items from each test is significant when value is higher or equal to 0.80

[4)] KMO – Kaiser-Meyer-Olkin – coefficient around .90 is excellent representativity, around.80 very good; around .70 good; .60 average; .50 the test have bad representativity and below.50 unacceptable

**Table 3.** Throwing medicine ball 1 kg from standing position (ESFMST) reliability, validity and representativity obtained at 7 years old children

| Ajtems | r and SMC | | H 1 | $h^2$ |
|---|---|---|---|---|
| **ESFMST 1** | (.71) | | .96 | .92 |
| **ESFMST 2** | .84 | (.71) | .96 | .92 |
| **Cronbach's α** | .91 | | Lambda | 1,84 |
| **SB** | .92 | | % | 92,22 |
| **KMO** | .50 | | | |

**Table (4)** Throwing medicine ball 1 kg from sitting position (ESFMG) reliability, validity and representativity obtained at 7 years old children

| Ajtems | r and SMC | | H 1 | $h^2$ |
|---|---|---|---|---|
| **ESFMG 1** | (.57) | | .94 | .88 |
| **ESFMG 2** | .75 | (.57) | .94 | .88 |
| **Cronbach's α** | .86 | | Lambda | 1,75 |
| **SB** | .86 | | % | 87,70 |
| **KMO** | .50 | | | |

**Table 5.** 20m dash running (ES20VS): reliability, validity and representativity obtained at 7 years old children

| Ajtems | r and SMC | | H 1 | $h^2$ |
|---|---|---|---|---|
| **ES20VS 1** | (.62) | | .95 | .89 |
| **ES20VS 2** | .79 | (.62) | .95 | .89 |
| **Cronbach's α** | .88 | | Lambda | 1,79 |
| **SB** | .88 | | % | 89,30 |
| **KMO** | .50 | | | |

## DISCUSSION

According the results presented in Table 1, declination from normal distribution is noted only at the test standing broad jump (ESSDM). In other three tests, except in the test 20m dash running (ES20VS), examiners achieve better results in the second measurement. This could be explained with better understanding on the requirement of the tasks, greater activity in second measurement and better results. Lower results in the second repetition obtained at the test 20m dash running (ES20VS), are probably result of fatigue that occurs after the first running in which all children`s capacities are maximally used and children are highly motivated.

According the values of the tests for discriminativity (the relation of x and SD, 3:1) and asymmetry (skwenes), applied tests are sensitive and relatively hard to perform. Exception from this is the test standing broad jump (ESSDM) which, according the test`s results is determined as easy test for 7 years old children.

Results for reliability, validity and representativity of every of applied tests are presented in Tables 2,3,4 and 5. Values of Spirman – Brown and Cranach's α coefficients of reliability (from .86 to .95) of all four movement tasks point out on high reliability of all applied tests. The highest coefficient of reliability (.95) is determined for the test Standing broad jump (ESSDM).

Validity of applied tests is determined using factor analysis. Using Hotelling procedure of results from both repetitions in all four applied tests for explosive strength, one significant root for every factor is isolated and it explains the variability of the applied systems with values from 87,70% to 95,32% or particulary with high 95,32% is explained variability of the test Standing broad jump **(ESSDM),** with 92,22% is explained the variability of the test Throwing medicine ball 1 kg from standing position (ESFMST), 87.70% for the test Throwing medicine ball 1 kg from sitting position **(ESFMG)** and 89.30%

For the variability of the system of the test 20 m dashes running (ES20VS). Highly explained variability points out that results obtained in both repetition on the same test are not significantly different which is confirmed with high projections of isolated factor for each test (from .94 to .98). The high factor validity obtained for applied tests for estimation of explosive strength is also confirmed with significant coefficients of correlation between results of each repetition of every single test (from .75 to .91).

High values of communalities from 88 to .95 of isolated factor of every single test confirm the homogeneity of obtained results. Values of KMO index for representativity and reliability of all four movement tasks for estimation of explosive strength is on a limit of significance (.50).

In general, results obtained for validity, reliability and representativity of the tests for estimation of explosive strength used with 7 years old children indicates to tests with significant metric characteristics and are proper for further use. In situations of limited conditions for realization of measurement or in situation where short battery of tests is needed as a test with the best metric characteristics from these group of tests, we recommend the test Standing broad jump (ESSDM) use for estimation of explosive strength of legs and the test Throwing medicine ball 1 kg from sitting position (ESFMG) for estimation of explosive strength of arms and shoulders. Similar results are obtained in the research realized by Perić (1991) in which the test Standing broad jump is one of the tests used in the suggested battery recommended for use with pre – school children, as well as with the results obtained in researches of Rajtmajer, 1997; Bala, 1999; Popeska, 2009.

Norms for children`s achievements in motor tests for estimation of explosive strength are calculated based on a distribution of frequencies of results (Table 6). They are use with aim to follow the children`s individual improvements and their achievements in motor tests. These results are presented in Table 6. as norms for evaluation of achievements of motor tests. They are divided in five percentile classes (excellent achievement, achievement above average, average achievement, achievement below average and very bad achievement). These norms are orientation values that could facilitate the teacher or the sport pedagogic in the process of following, evaluation and comparison of children's achievements.

**Table 6.** Norms for children`s achievements in tests for estimation of explosive strength

| | | **Standing broad jump (ESSDM)** | **Throwing medicine ball 1 kg from sitting position (ESFMG)** |
|---|---|---|---|
| | | **7 years** | **7 years** |
| **1** | Very bad achievement | To 77,91(sm) | To 1,06 (sm) |
| **2** | Below average achievement | 77,92 – 95,71 | 1,07 – 1,30 |
| **3** | Average achievement | 95,72 – 126,45 | 1,31 – 1,98 |
| **4** | Achievement above average | 126,46 – 139,23 | 1,99 – 2,77 |
| **5** | Excellent achievement | Above 139,23 | Above 2,78 |

Efficiency and children`s achievements on motor tests, including tests for evaluation of explosive strength, are highly determined and conditioned from certain characteristics that occurs as a result of children's` age. In this since, we could talk about children emotional instability (Gallahue, 1987), their motivation and readiness for full activation of all potentials (Jürimae & Jürimae, 2001), disorientation from the goal and understanding of testing as a game, which is especially noted in younger children. These and many other similar situations are the reason for many practical problems during the testing process with young children noted in these type of researches (Rajmajer, 1997). These findings allows certain activities, such as motivation, encouraging, demonstration and previous tries of the motor tasks, which are unacceptable in work with adults to be justified and recommended in work with children (Bala, 1999; Jürimae & Jürimae, 2001). Therefore, in researches from this type as well as in everyday work with children, knowledge and appreciations of characteristics of children emotional and psychological development as well as their influence on children's motor abilities are essential. This means respect of holistic approach in work with children.

From the aspect of number of repetitions of suggested tests, we recommend to maintain the same number as in the suggested methodology of measurement, considering the development possibilities of 7 years old children (Bala, 1999, Delaš et al, 2008)

## CONCLUSION

Explosive strength in relation with other motor abilities defines the structure of motor space, the level of acquisition of certain movements, or certain motor behavior of children. Explosive strength, esspecialy in the early school period is related with successful performance of many movements and is closely related with other motor abilities, esspecialy with coordination and speed. The success in performannce and realisation of PE tasks and contents is highly related with motor abilities and the level of their developent. On the other hand, folowing the development and improvement of motor abilities we could folow and estimate the effects of realisation of PE teaching process. Therefore, the aim of this paper is to determine metric characteristics of motor tests used for estimation of explosive strength at 7 years old children and normative for evaluation of children's achievements as an objective for determination of children's achievements and following of their individual improvement.

The research was conducted as a part of larger study (Popeska, 2011) resalised on a sample of 123 examiners, 7 years old male children, pupils in second grade in five primary schools in Skopje, Republic of Macedonia. The examiners were tested in four motor tests hypothetically used for estimation of explosive strength. Following tests were used: Standing broad jump (ESSDM), Throwing medicine ball 1 kg from standing position (ESFMST), Throwing medicine ball 1 kg from sitting po-

sition (ESFMG) and 20m dash running (ES20VS). Tests characteristics: discriminativity (sensitivity), asymmetric, homogeneity, reliability, validity and representatively are fortified for all four used tests. Obtained results point out on sensitive and homogenenous tests. All four applies tests for estimation of explosive strength has high reliability and validity, while the representativity is on a level of significance. According values of coefficients, as a test with best metric characteristics proper for use with 7 years old children we recommend the test Standing broad jump **(ESSDM)** use for estimation of explosive strength of legs and the test Throwing medicine ball 1 kg from sitting position **(ESFMG)** for estimation of explosive strength of arms and shoulders. For all recommended tests, we suggest norms for following and estimation of children's achievements.

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